

**REMARKS**

The specification has been amended to include various headings as considered appropriate and to include a section with a brief description of the drawings, in view of the Examiner's comments in the Office Action. Claim 25 has been amended to incorporate the recitations of claim 30, as well as to include recitations based on the disclosure at, e.g., page 8, lines 3-5, and based on a carbon number issue raised by the Examiner (claims 29 and 33 have also been amended with respect to the carbon number issue). In view of the amendment of claim 25, Applicants have canceled claim 30 and amended the dependency of claim 51. Also, Applicants have amended claim 46 for purposes of further clarification without changing its scope.

Entry of the above amendment is respectfully requested.

**Restriction**

On page 2 of the Office Action, in paragraph 1, the Examiner acknowledges Applicant's election with traverse of Group I.

In this regard, Applicants note that the Examiner indicates that claims 25, 30-36 and 40-53 are the claims of Group I, and that claims 26-29, 37-39 and 54-57 are held withdrawn from consideration as being drawn to a non-elected invention. However, Applicants submit that present claims 37, 54 and 55, which are directed to a solid product, are similar to previous claim 13, which was directed to a solid product, and claim 13 was indicated in the Office Action of February 25, 2009 as being in Group I. Accordingly, while claims 37, 54 and 55 have been identified above as withdrawn, Applicants submit that they should be part of elected Group I.

Further, Applicants note that non-elected claims 26-29 are process claims depending directly or indirectly on elected process claim 25. Accordingly, Applicants respectfully request rejoinder of claims 26-29 upon a finding of allowable subject matter in claim 25, pursuant to MPEP 821.04(a).

### **Specification**

On page 2 of the Office Action, in paragraph 2, the Examiner requests Applicants' cooperation in correcting any errors of which Applicants may become aware in the specification. Also, on page 2 of the Office Action, in paragraph 3, the Examiner has objected to the disclosure because a section heading Brief Description of the Several Views of the Drawing(s) is required, as is a reference to and brief description of the drawings.

In response, Applicants have amended the specification to include section headings, including a section heading Brief Description of the Several Views of the Drawings with a reference to and brief description of the drawings (with respect to the drawings themselves, Applicants note that the drawings should be the same as those in the PCT application (of which the present application is the national stage), which are also the drawings in the publication of the present application; if such is not considered to be the case by the PTO, though, the PTO is respectfully requested to advise Applicants, so that this matter can be resolved).

In view of the above, Applicants submit that the specification should be acceptable, and withdrawal of the objection to the disclosure is respectfully requested.

### **Rejections under 35 U.S.C. 112, Second Paragraph**

On page 3 of the Office Action, in paragraph 4, claims 25, 30-36 and 40-53 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite, because the possible identities for the variable "X" are not set forth. Also, on page 3 of the Office Action, in paragraph 5, claim 46 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite.

Applicants respectfully submit that the present claims satisfy the requirements of 35 U.S.C. 112, second paragraph, and request that the Examiner reconsider and withdraw these rejections in view of the following remarks.

With respect to the first issue raised by the Examiner, it is noted that claim 25 previously recited that each X<sup>-</sup> independently represented an anion, so it is submitted that the identity of that variable was clearly set forth. Nevertheless, Applicants have amended claim 25 to recite that each X<sup>-</sup>, independently, represents an anion selected from the group consisting of halides and sulfonates. Accordingly, Applicants submit that the possible identities of this variable are clearly set forth in the amended claim.

As to the second issue raised by the Examiner, it is not clear to Applicants why the Examiner has rejected claim 46, since no specific reason is set forth in the Office Action. Applicants note that claim 46 is dependent upon claim 33 and defines the R<sup>4</sup> group of the formula (IV) given in claim 33. While Applicants believe this point was clear, Applicants have amended claim 46 in this regard for the purpose of further clarification without changing the scope of the claim. If the Examiner still considers claim 46 to be indefinite, though, he is requested to set forth the reason with specificity in a new non-final Office Action so that Applicants will have an adequate opportunity to respond.

In view of the above, Applicants submit that the present claims satisfy the requirements of 35 U.S.C. 112, second paragraph, and withdrawal of these rejections is respectfully requested.

### **Obviousness Rejection**

On page 4 of the Office Action, in paragraph 6, claims 25, 30-36 and 40-53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Crass et al (US 2003/0191264 10-2003) when considered with Riondel et al (US 2003/0100679-A1 05-2003) and Kikuchi et al (JP 10-158,224-A 06-1998, machine translation).

In response, Applicants note initially that when discussing the patentability of the invention, the Examiner has indicated in paragraph 6 that he considers the definition of the alkyl groups as comprising 1-4 carbon atoms to allow for any arbitrary number of carbon atoms in the alkyl groups. To avoid such a broad interpretation, Applicants have amended the first two lines below formula (I) in claim 25 to recite that each  $R^2$ , independently, represents a C1 to C4 alkyl.

Also, Applicants note that the first line below formula (II) in claim 25 has been amended to recite an aprotic dipolar organic solvent, based on the recitations of claim 30.

Thus, the present invention as defined in claim 25 relates to a process for the manufacture of a (meth)acrylate di-ammonium salt of formula (I) starting from the corresponding di-amino (meth)acrylate of formula (II) which is made to react with the quaternizing agent  $R^3X$ . A problem with this type of process in general is that the first amino group reacts quite easily with the quaternizing agent while the second amino group is much more difficult to react with this quaternizing agent. Consequently, on the one hand, it is difficult to obtain a high yield of the di-ammonium salt (high selectivity), and on the other hand, it is difficult to obtain a high purity due

to the relatively high amount of the mono-ammonium salt which will remain in the reaction mixture.

The Examiner only cites one document which discloses the quaternization of a di-amino (meth)acrylate, namely US 2003/0100679 (Riondel et al.). The di-amino (meth)acrylate is first dissolved in an organic solvent and is subsequently allowed to react with the quaternizing agent (see paragraphs [0039] and [0040]). The organic solvent is, for example, chloroform, dichloromethane, dichloroethane or mixtures thereof (see paragraph [0046]). The produced mono- or di-ammonium salt is then extracted from the organic solvent by means of water (see paragraph [0045]).

In US 2003/0100679, only one example of a quaternization reaction is given, namely, Example 2, wherein the di-amino acrylate S-ADAME is quaternized in a solution in  $\text{CHCl}_3$  (chloroform) by means of benzyl chloride as a quaternizing agent. Exactly 1 mole of quaternizing agent is used per mole of S-ADAME so that the mono-ammonium salt S-ADAMQUAT BZ is produced. This example is thus not in accordance with the present invention wherein the di-ammonium salt is to be produced, which would be in the present example S-ADAMQUAT 2BZ.

Applicants note that Riondel et al. have filed another US patent application, namely, US 2003/0050417, which has the same priority date as US 2003/0100679 and which has a content which corresponds largely to US 2003/0100679, except for the fact US 2003/0050417 relates to the production of the di-ammonium salt. Example 2 is in particular identical to Example 2 of US 2003/0100679 except of the fact that the 44.2 g S-ADAME are allowed to react

with 55.9 g of benzyl chloride instead of with 28 g thereof. In this example, somewhat less than 2 moles of benzyl chloride are thus allowed to react with one mole of S-ADAME to produce the di-ammonium salt S-ADAMQUAT 2BZ. As explained on page 3, lines 23-25 of the present application, it is important in the prior art process not to add more than 2 moles of benzyl chloride per mole of the di-amino (meth)acrylate since otherwise, upon extraction of the di-ammonium salt by means of water, acid will be generated in the water causing a hydrolysis of the (meth)acrylate ester. In the process of Riondel et al., it is thus not possible to add a larger amount of quaternizing agent to increase the yield and/or purity of the produced di-ammonium salt.

Comparative tests 35 and 36 described on pages 17 to 18 of the present application have been carried out following the procedure described in US 2003/0050417 (which corresponds to the international patent application WO 01/55089 referred to on page 17, line 14 in the present application).

The results obtained by these comparative tests 35 and 36 demonstrate that the produced di-ammonium (meth)acrylate salt has a relatively low purity and contains in particular a relatively large amount of the mono-ammonium (meth)acrylate salt. As already set forth on page 1, lines 19-20 of the present application, it is almost impossible to purify the mixture of mono- and di-ammonium salts. Moreover, as explained hereabove, the process of Riondel et al. also does not allow the addition of more quaternizing agent, since this would cause a hydrolysis of the (meth)acrylate ester in the aqueous solution.

According to the present invention, it has been found that the di-ammonium (meth)acrylate salt can be produced with a much higher purity when replacing the solvents disclosed in Riondel (wherein the di-amino (meth)acrylate and the mono- and di-ammonium (meth)acrylates are soluble) by the claimed aprotic dipolar organic solvent wherein the di-ammonium salt has a solubility of less than 1 g/100 g of solvent and wherein the mono-ammonium salt has a solubility of at least 20 g/100 g of solvent. This is due first of all to the fact that the di-ammonium salt precipitates while most of the mono-ammonium salt remains in the solution. Moreover, due to the small amount of the di-ammonium salt in the solution and the relatively high amount of mono-ammonium salt, this mono-ammonium salt is quaternized more easily, resulting in a high yield and thus also in a higher purity. Since no water is used to extract the di-ammonium salt from the solution, it is also possible to use a larger amount of quaternizing agent, in particular more than 2 moles thereof per mole of the di-amino (meth)acrylate, so as to further increase the yield, or in other words, so as to reduce the remaining amount of mono-ammonium salt in the solution and thus increase the purity of the obtained di-ammonium salt.

None of the documents cited by the Examiner in this rejection discloses the use of a solvent wherein the mono-ammonium (meth)acrylate salt remains in solution while the di-ammonium (meth)acrylate salt precipitates out of the solution.

Kikuchi teaches a process wherein a mono-amino (meth)acrylate (instead of a di-amino (meth)acrylate) is quaternized by means of a quaternizing agent to produce a mono-ammonium (meth)acrylate salt. The quaternization reaction is performed in a solvent, in particular in

acetone or N-methylpyrrolidone, wherein the mono-amino (meth)acrylate is dissolved. The produced mono-ammonium salt precipitates out of this solution in the form of crystals.

Applicants submit that for one of ordinary skill in the art, it would not have been obvious to use the solvents disclosed in Kikuchi in the process of Riondel for producing the di-ammonium (meth)acrylate salt. As a matter of fact, due to the positively charged N-atom in the mono-ammonium salt produced as an intermediary product in the process of Riondel, a skilled person would expect that this mono-ammonium salt would precipitate out of the solution in the form of crystals as does the mono-ammonium salt in the process of Kikuchi. However, in the process of Riondel, the mono-ammonium salt has to be quaternized further to the di-ammonium salt. Consequently, a skilled person would try to keep the mono-ammonium salt in the solution so as to be readily available for further reaction with the quaternizing agent and so as to not pollute the di-ammonium salt which is precipitated in the form of crystals. Since none of the documents cited in this rejection teaches that the mono-ammonium salt produced in the process of Riondel may stay in solution in the solvents disclosed in Kikuchi while only the di-ammonium salt would precipitate out of these solvents, a skilled person would not have replaced the solvents used in Riondel by any of the solvents disclosed in Kikuchi.

The present inventors have found quite by surprise that there are aprotic dipolar organic solvents wherein only the mono-ammonium (meth)acrylate salt is soluble while the di-ammonium (meth)acrylate salt is not, and that when using such aprotic dipolar solvents for the quaternization reaction disclosed in Riondel, a higher yield and especially a much higher purity



of the di-ammonium (meth)acrylate salt can be achieved. Consequently, the process as claimed in claim 25 would not have been obvious to one of ordinary skill in the art.

With respect to Crass, it should be noted that, just like Kikuchi, Crass relates to a process wherein a mono-amino (meth)acrylate (instead of a di-amino (meth)acrylate) is quaternized by means of a quaternizing agent to produce a mono-ammonium (meth)acrylate salt. A further difference from the process of the present invention is that Crass does not use any solvent. In fact, the quaternizing agent, in particular methyl chloride, is injected in the mono-amino (meth)acrylate compound to produce the mono-ammonium (meth)acrylate salt. The mono-amino (meth)acrylate compound is a liquid wherein the gaseous methyl chloride is injected. This methyl chloride is thus not a solvent. When combining the teachings of Crass with those of Riondel, one of ordinary skill in the art would thus not have arrived at the process of the present invention, since he would simply have omitted the use of the solvent in the process of Riondel. However, this would certainly not have resulted in the same pure di-ammonium (meth)acrylate reaction product as in the process of the present invention, since if the produced di-ammonium (meth)acrylate salt is a solid product, the mono-ammonium (meth)acrylate salt would also be a solid product which is mixed with the di-ammonium (meth)acrylate salt and not or less readily available for the required further reaction with the quaternizing agent.

Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested.

**Conclusion**

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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